Characteristics and Ecological Impacts of Atmospheric Deposition in Urban and Urban-Affected Regions

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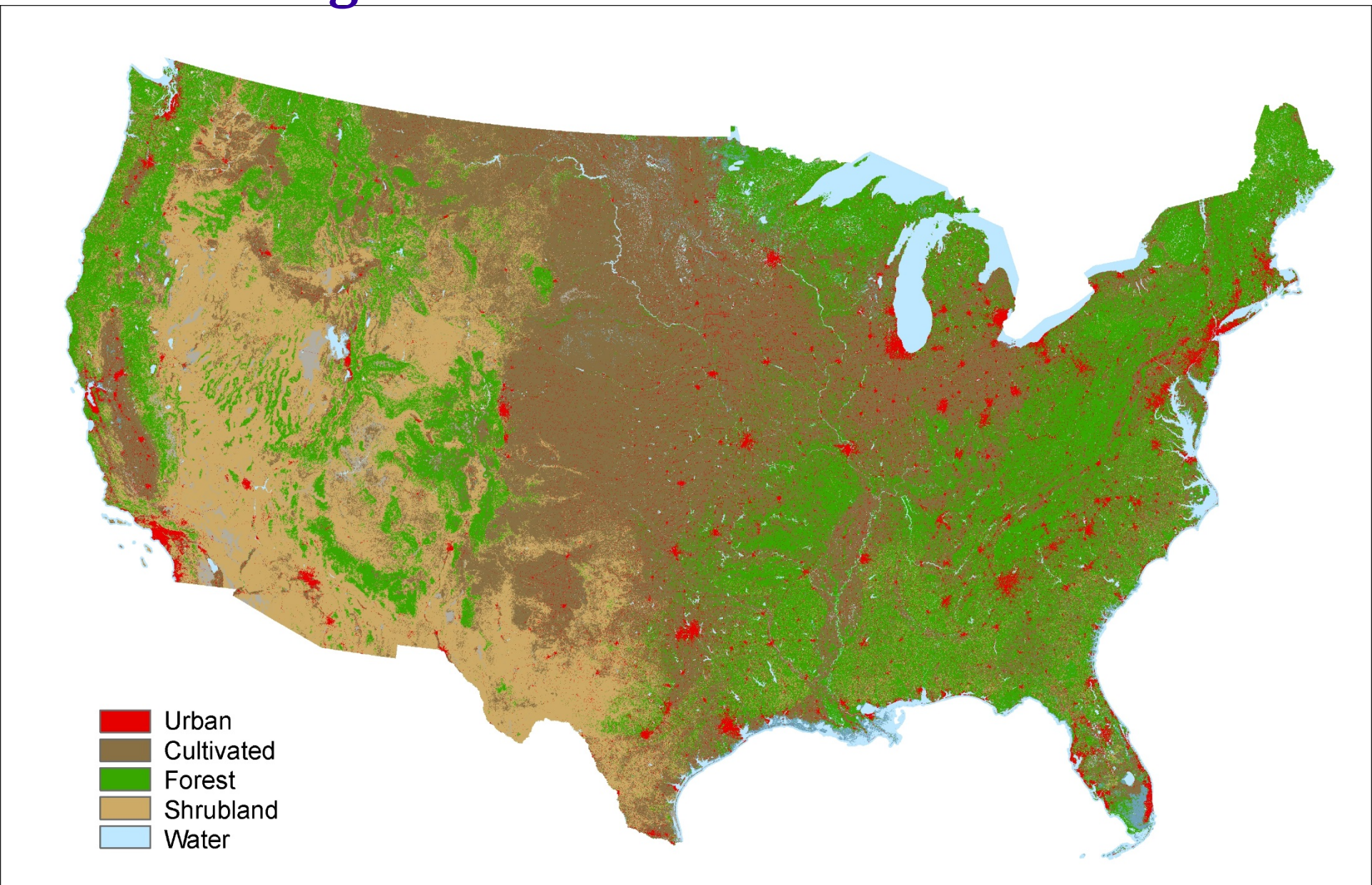
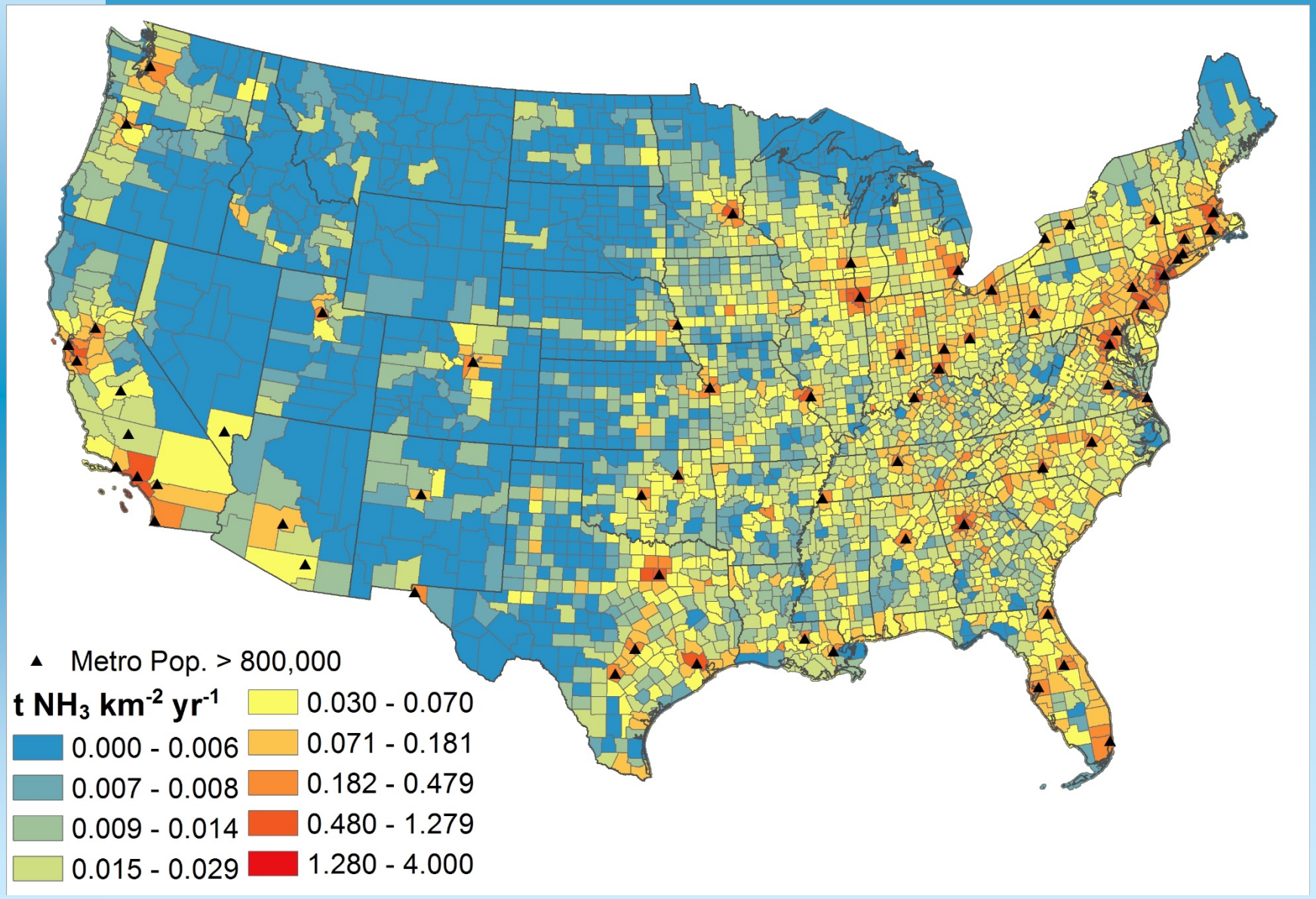
PSW Res. Stn.

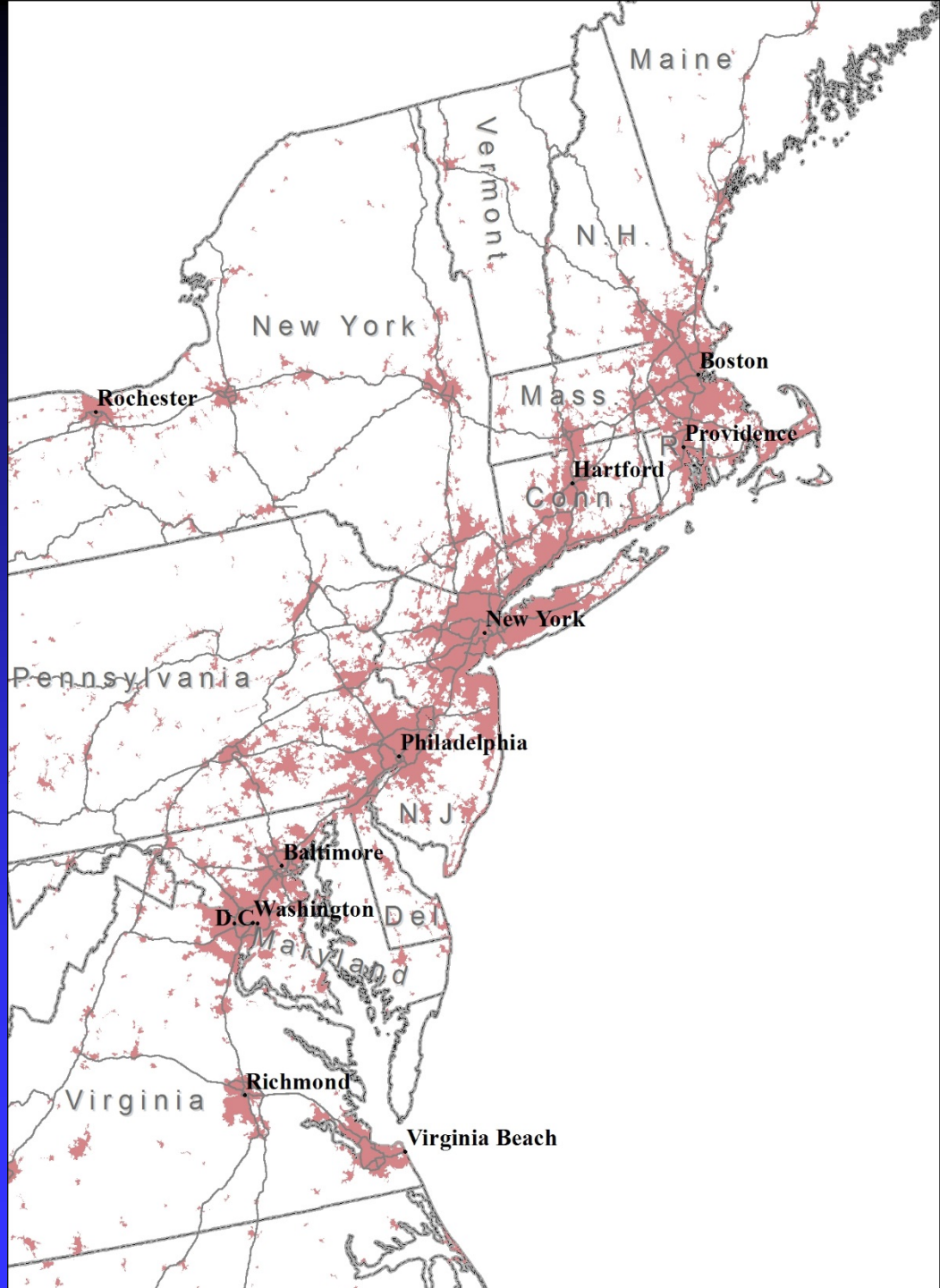
Land Cover Mosaic: How extensive is the footprint of ecological effects from urban emissions?



On-Road Emissions of NH_3 by County



Urban corridor from DC to Boston



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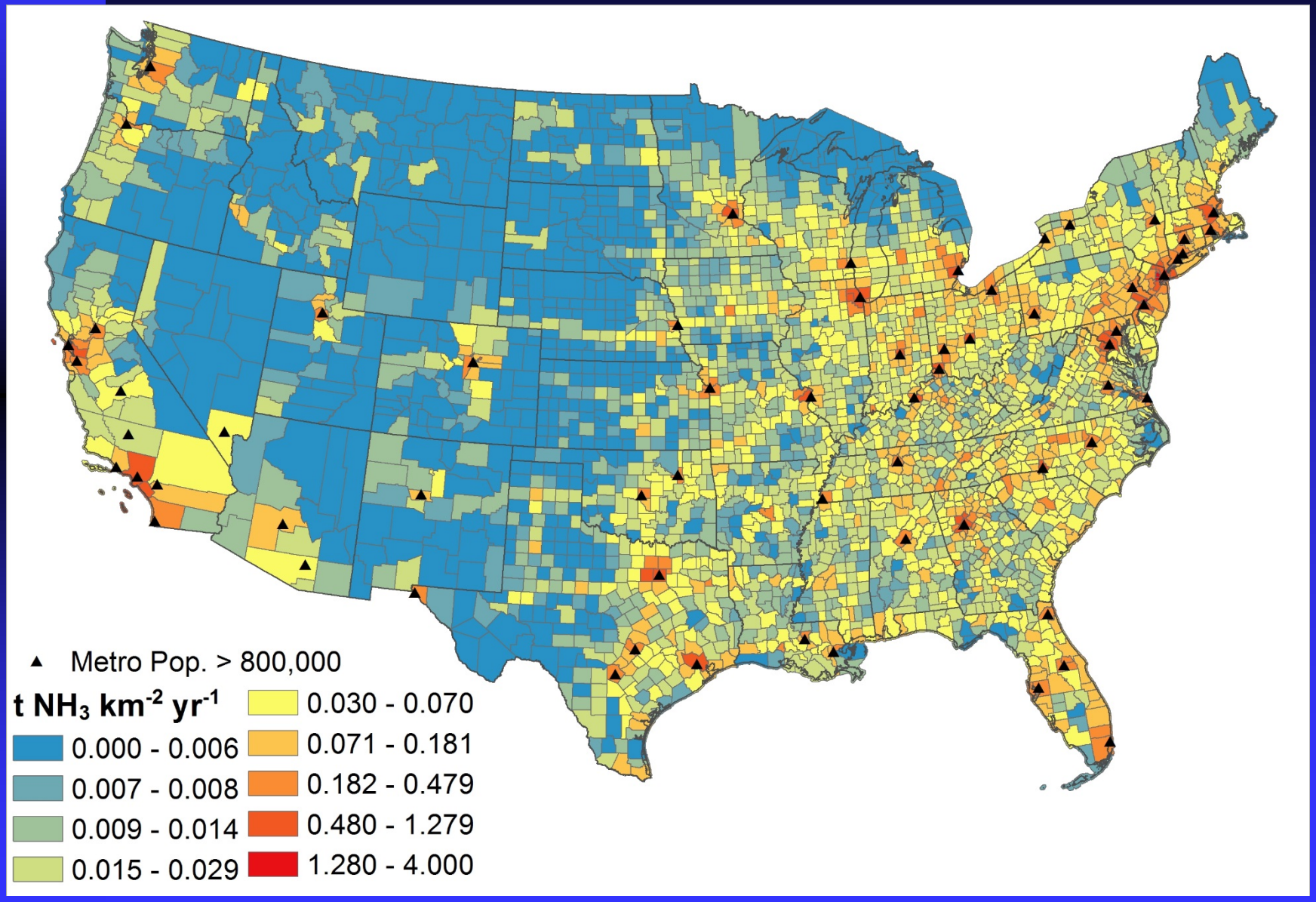
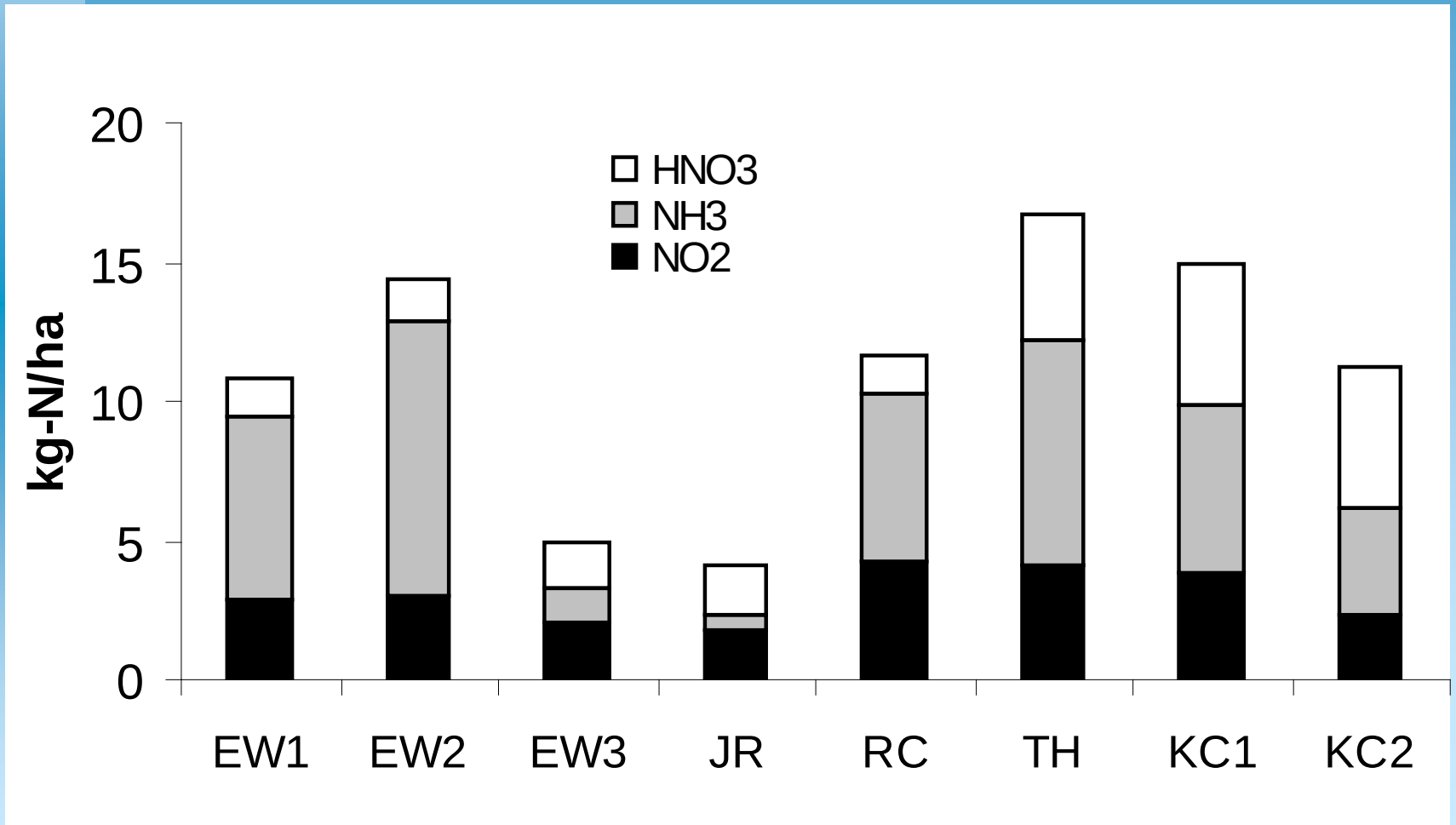
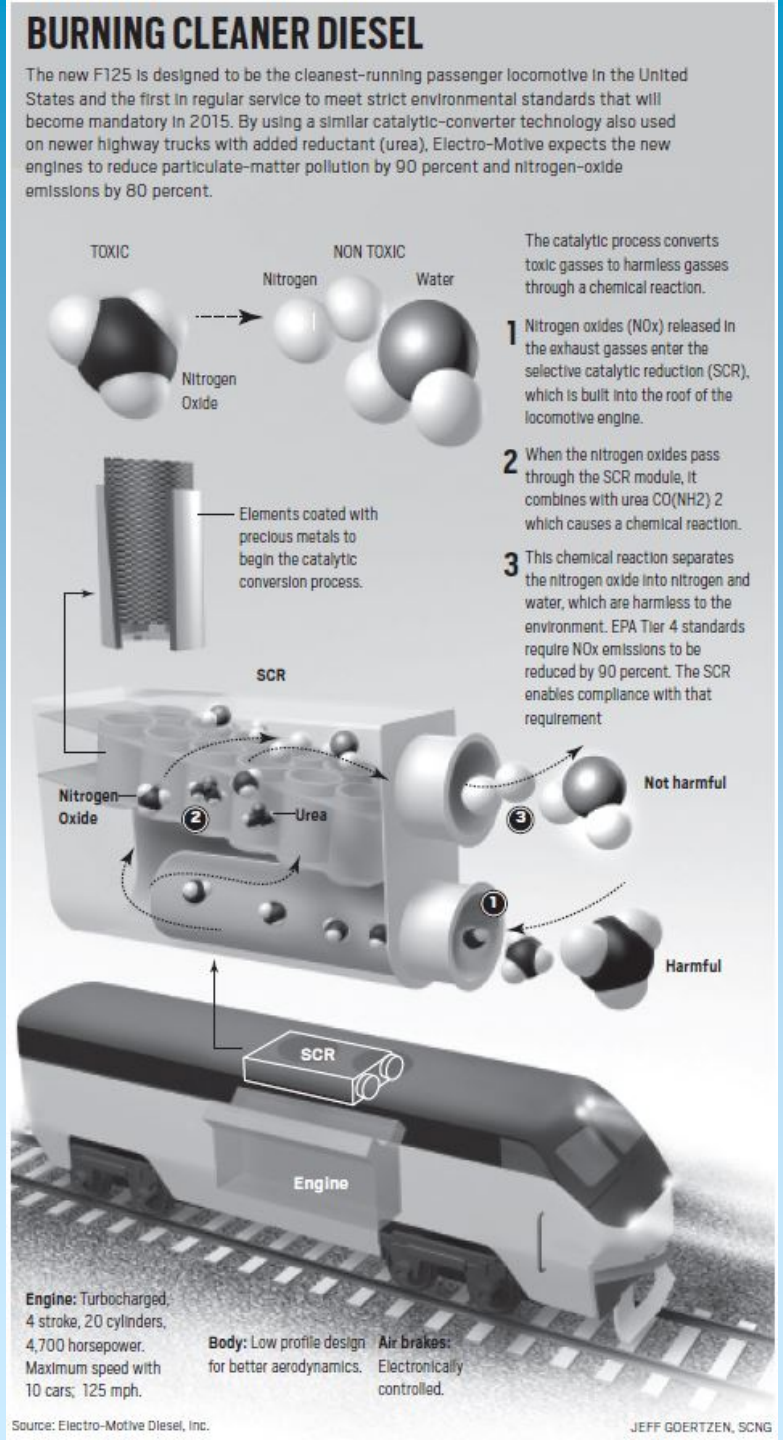


N gaseous pollutant deposition to a California grassland near a major highway (280) in the coastal San Francisco peninsula and in near-urban sites



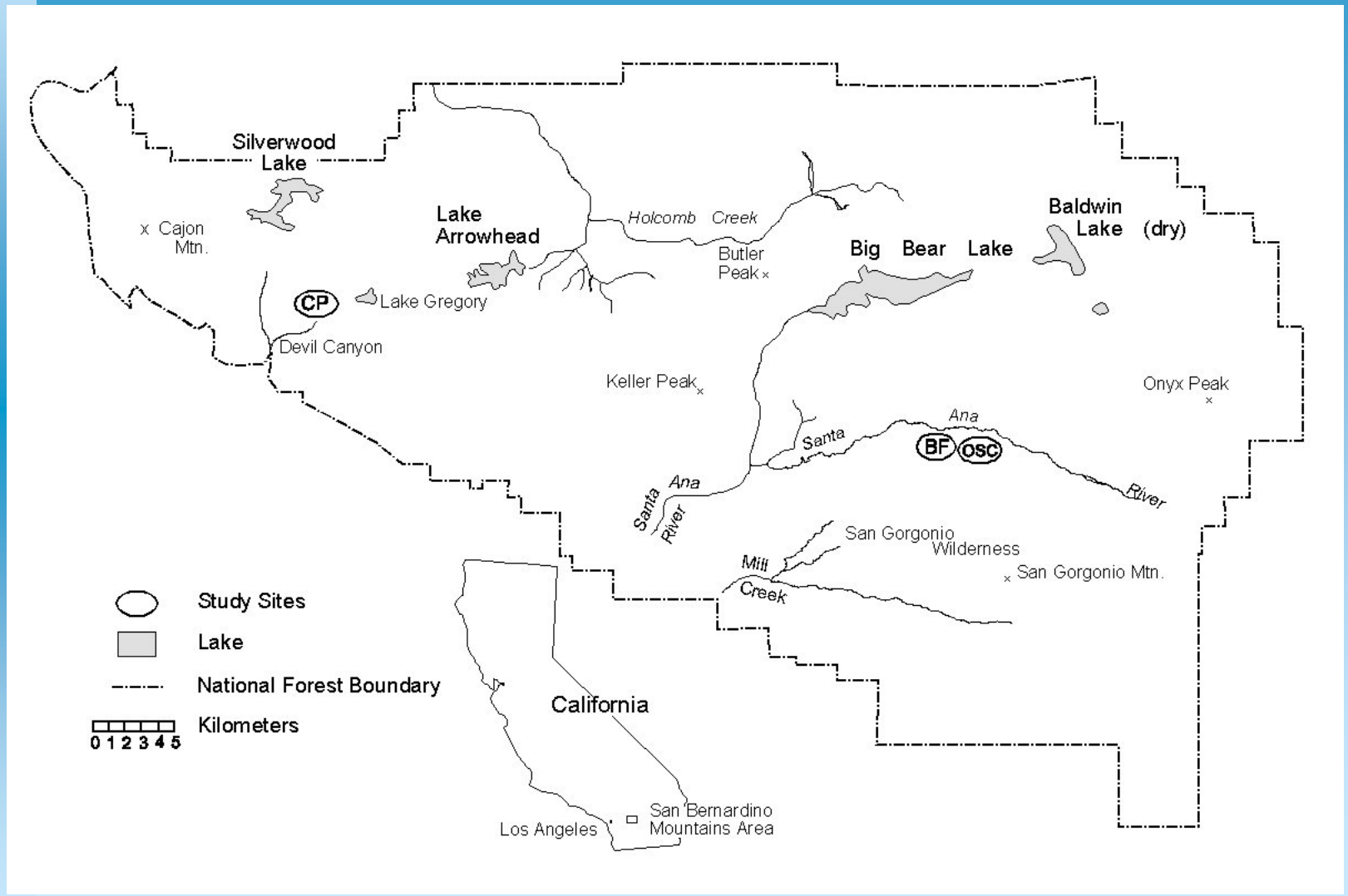
A recent example of the trend of increasing NH_3 production by additional types of vehicles and engines.



General Rule:

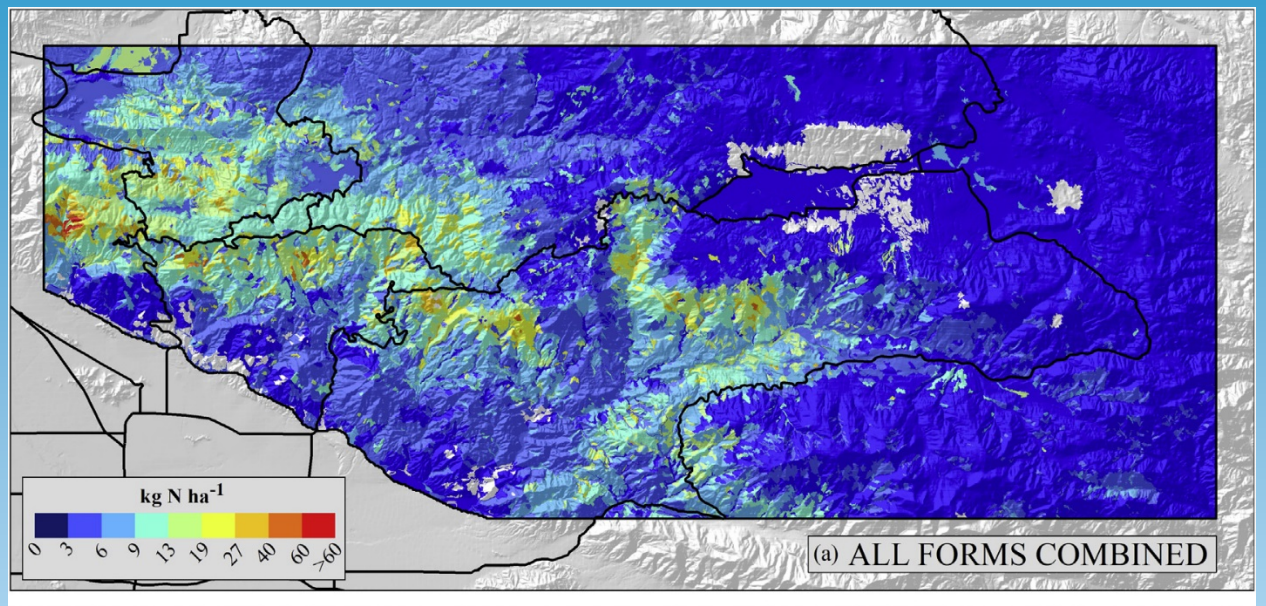
Conditions and emissions control mechanisms that result in highly effective NO_x reduction result in greater NH_3 production and emissions

San Bernardino Mountains Air Pollution Gradient

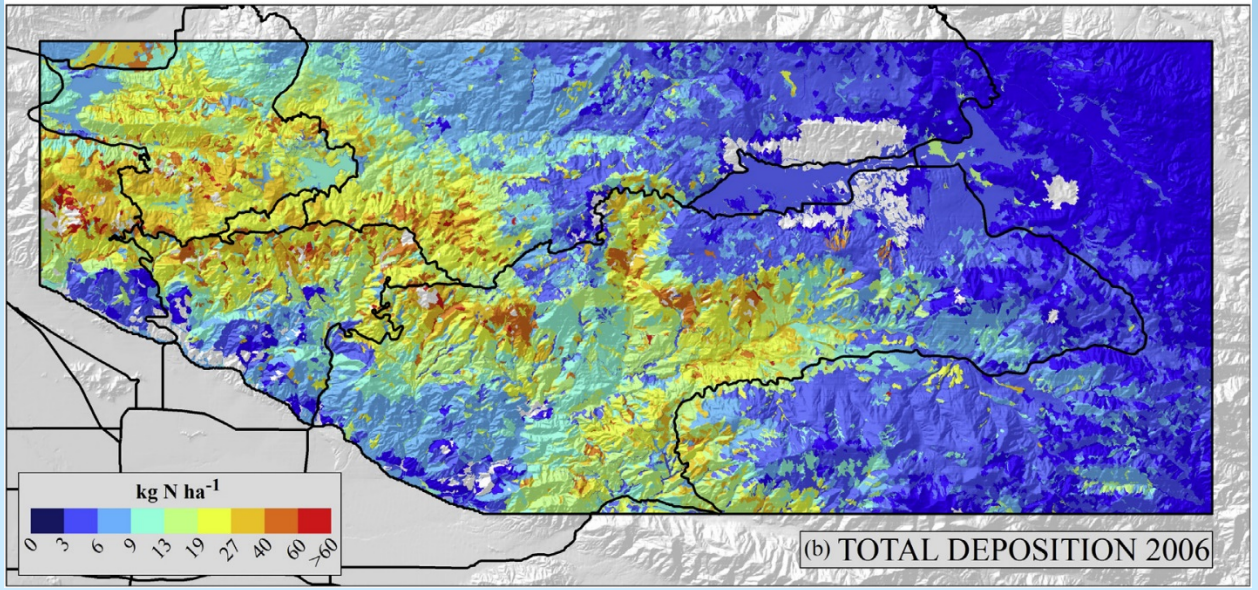


Steep N Deposition Gradient in San Bernardino Mts. in Southern California

Summer dry deposition



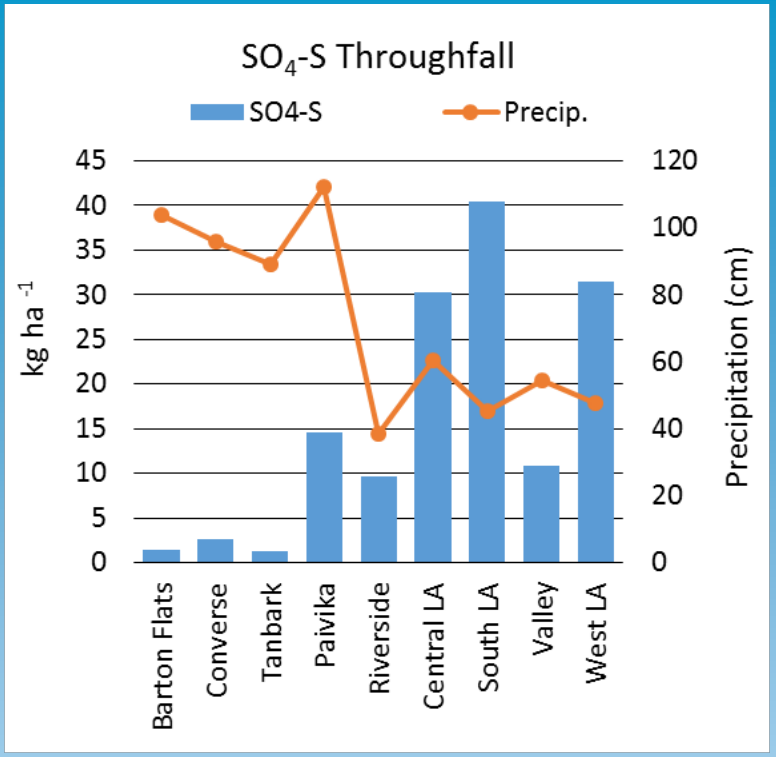
Annual total N deposition

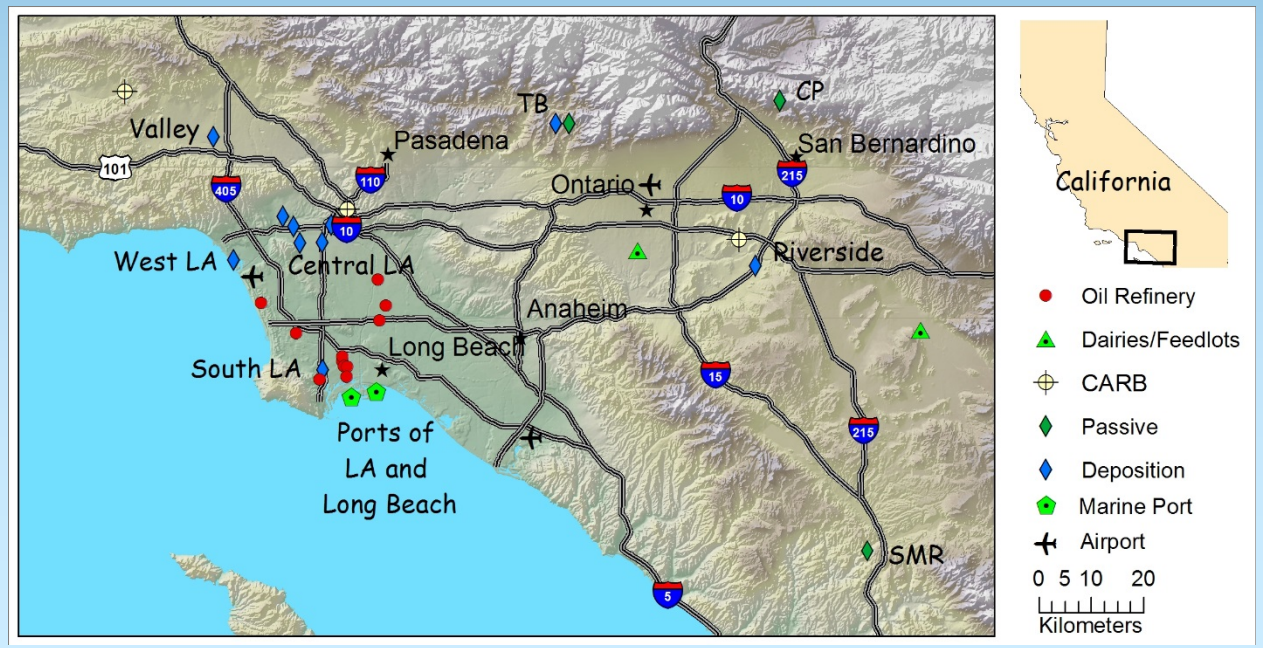


Ion exchange resin throughfall collector

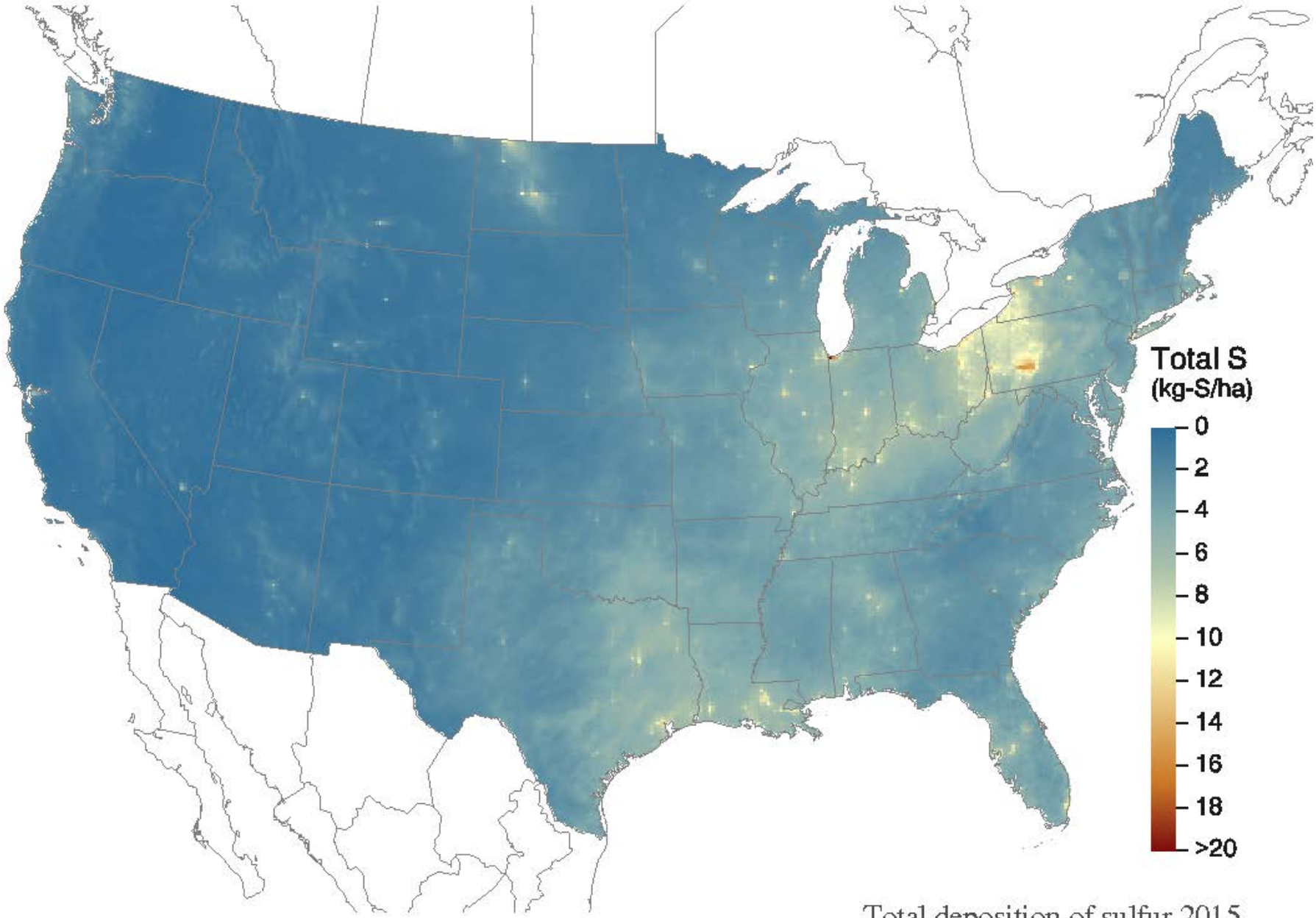
Method we also used for urban throughfall deposition monitoring

Sulfur Deposition in Urban and Montane sites in the Los Angeles Air Basin





Sulfate ion wet deposition, 2015



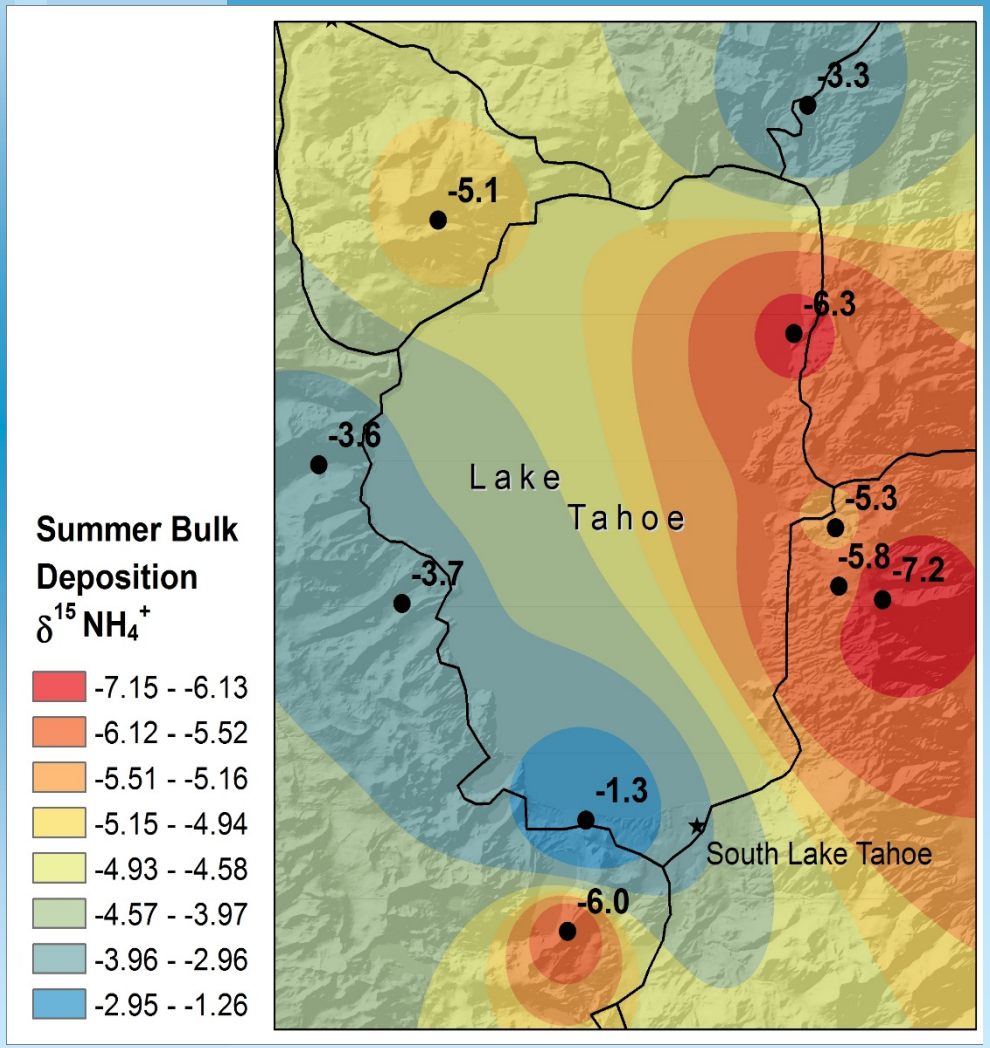
Total deposition of sulfur 2015

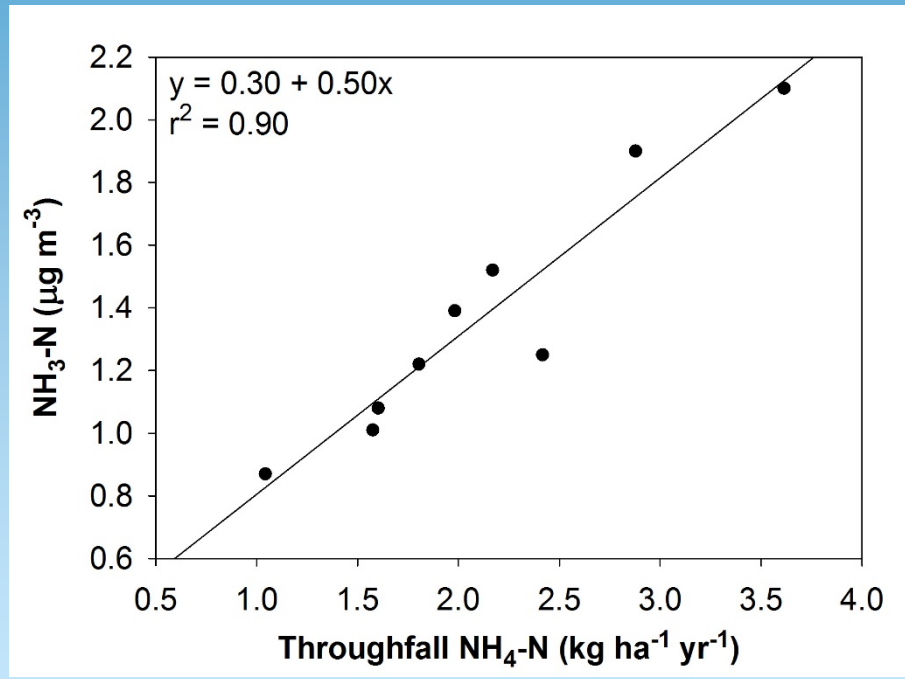
Source: CASTNET/CMAQ/NTN/AMON/SEARCH

USEPA 09/14/16

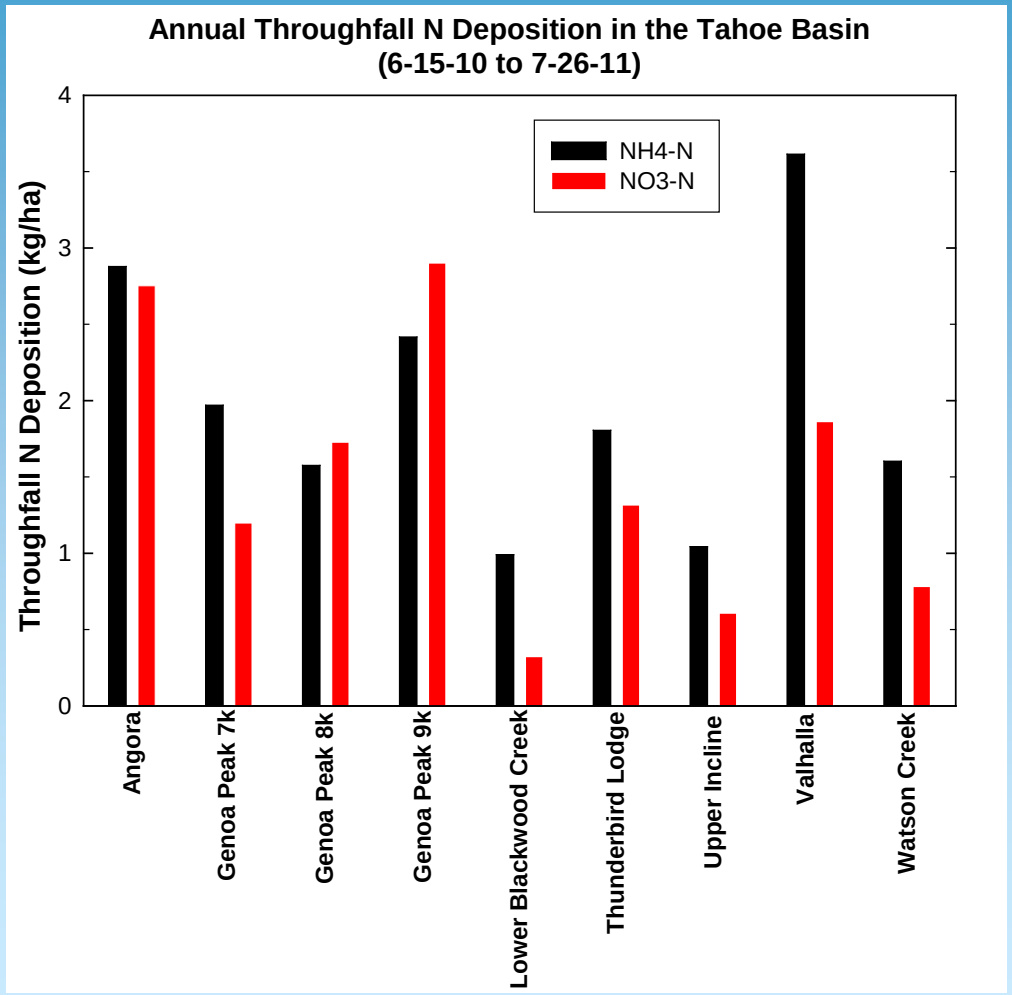
Lake Tahoe Basin---Affected by in-basin urban and on-road N emissions

Lake Tahoe Air Basin: Importance of Tailpipe NH_3 Emissions





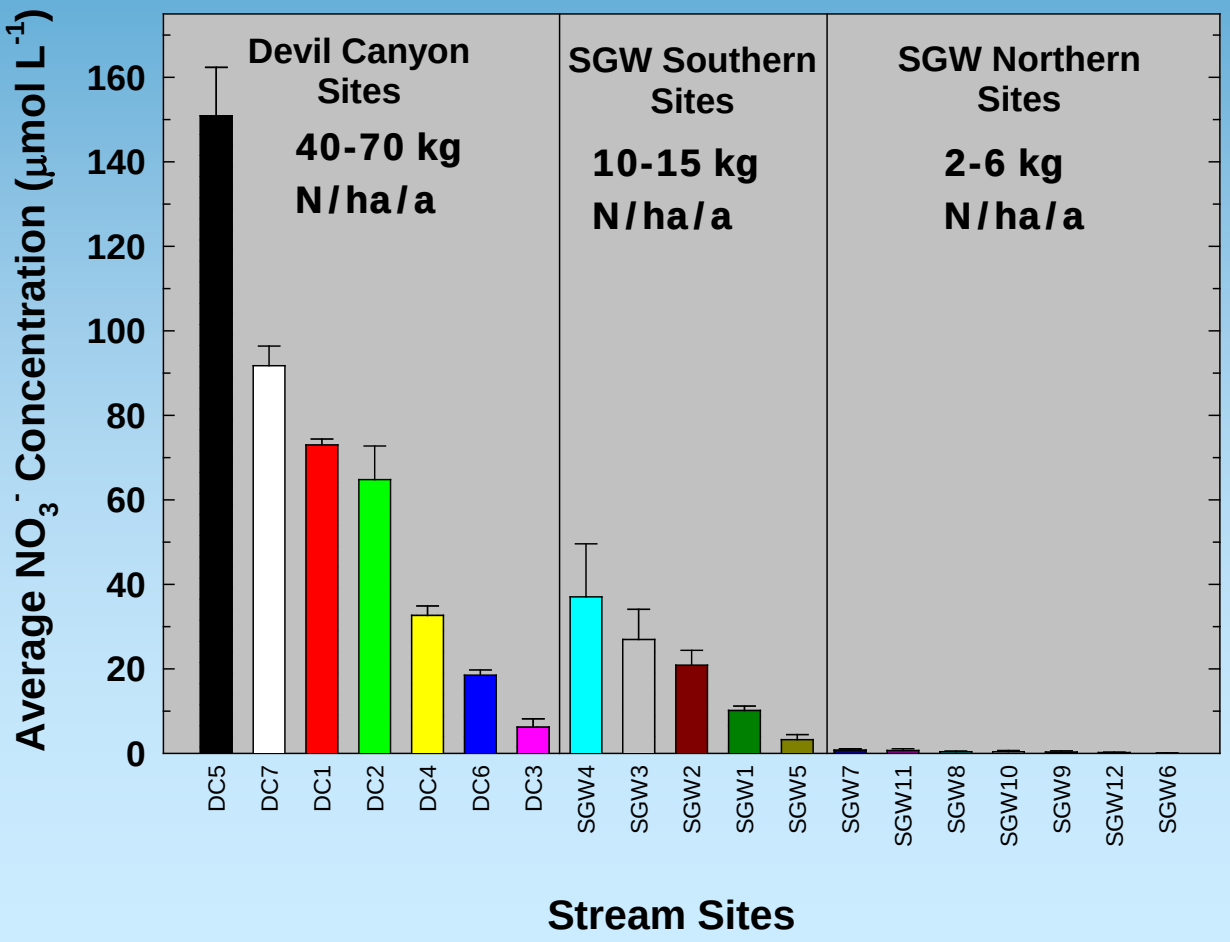
Lake Tahoe: Throughfall Deposition of N



Another General Rule:

N as a nutrient or eutrophication effects are predominant in urban-affected regions, although acidification effects also occur---depending on soil and site conditions.

Streamwater NO_3^- concentrations across a deposition gradient in the San Bdo. NF, downwind of greater Los Angeles



Smog In Our Water

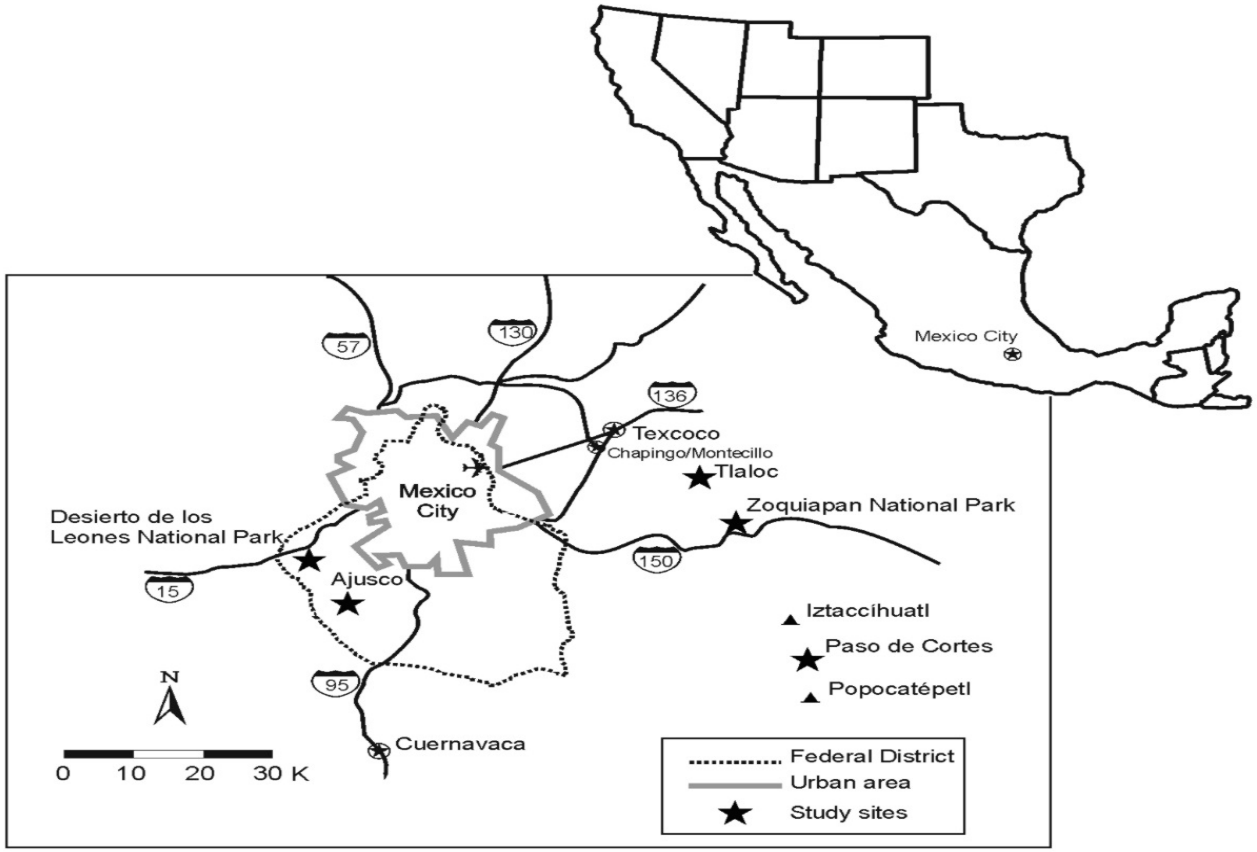
Carolita Feiring / *The Press-Enterprise*

"We drink what we drive."

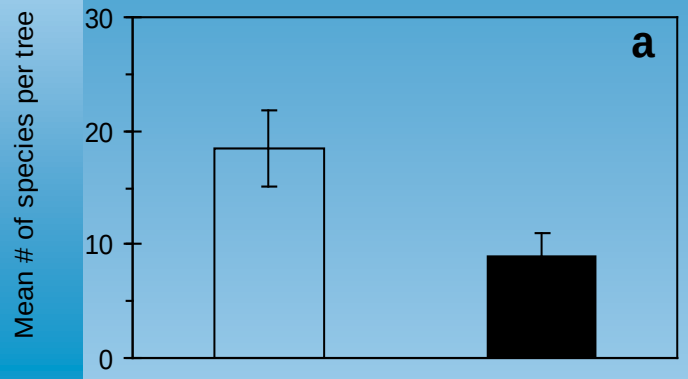
Major Air Pollution Impacts to CA Ecosystems Affected by Urban Emissions

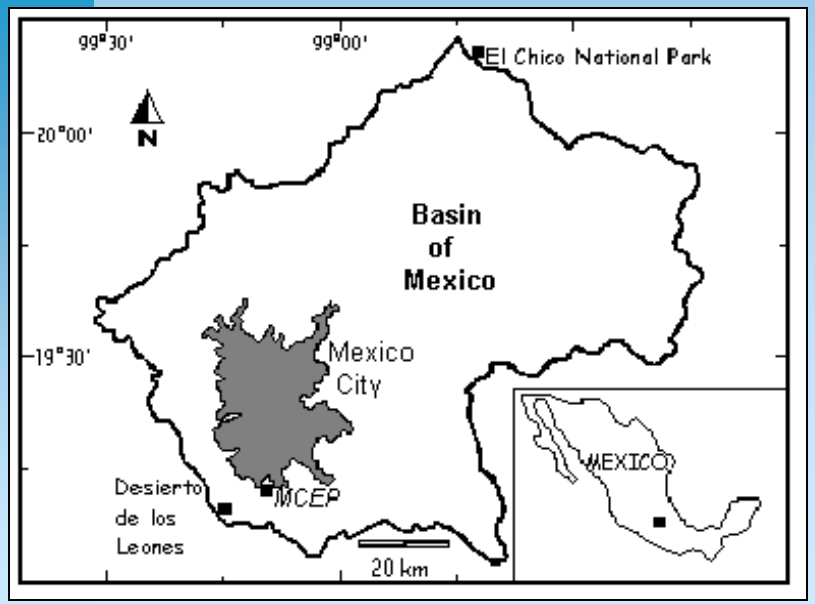
- **Forests: ozone & N co-occur; increased mortality, perturbed C & N cycling; N losses from the system, altered communities of epiphytic lichens, understory herbaceous species and mycorrhizal fungi; decreased C allocation below ground; increased fuel accumulation, stand densification and fire risk**
- **Chaparral and oak woodlands: Elevated NO_3 in runoff; altered lichen communities**
- **Desert scrub and pinyon-juniper: N deposition favors weedy invasives, increasing fire risk and vegetation type change**
- **Grassland: Community shift; loss of native species**
- **Coastal sage scrub: Altered mycorrhizal communities, plant community shifts, increase in invasive annual grasses**

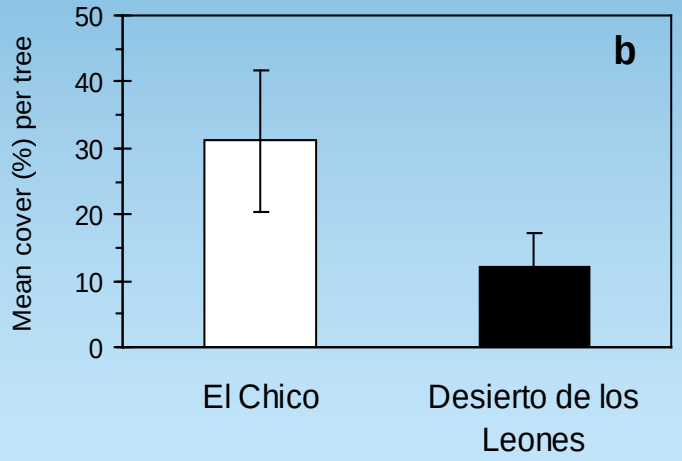
Mexico City Air Basin: Nitrogen and ozone impacted forests



Effects of Atmospheric Deposition on Lichen Communities in Mexico City

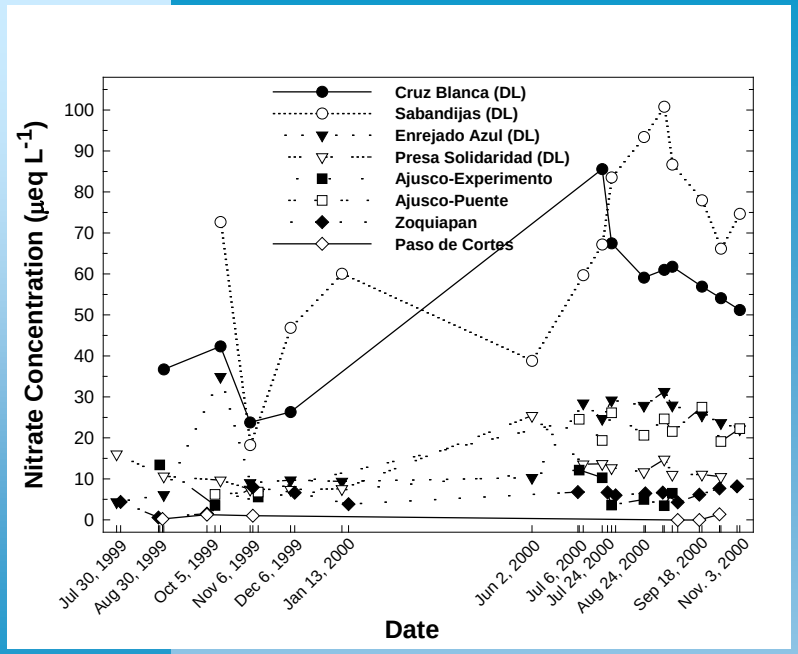


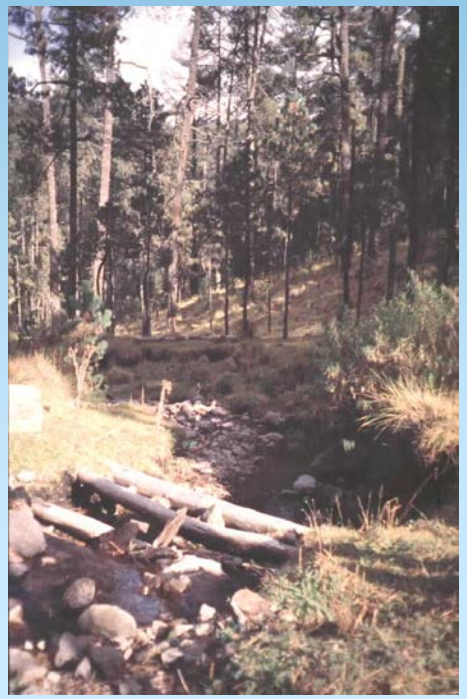


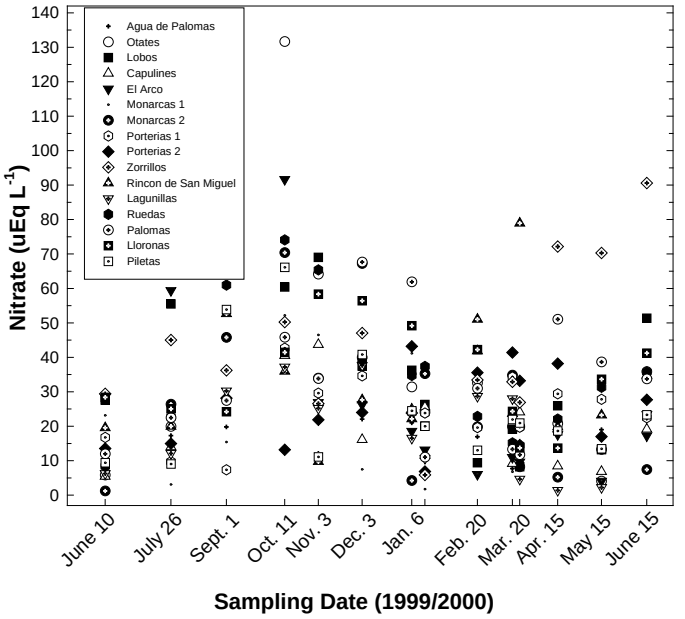


Zambrano et al., 2002

Nitrogen saturated catchments in forests downwind of Mexico City





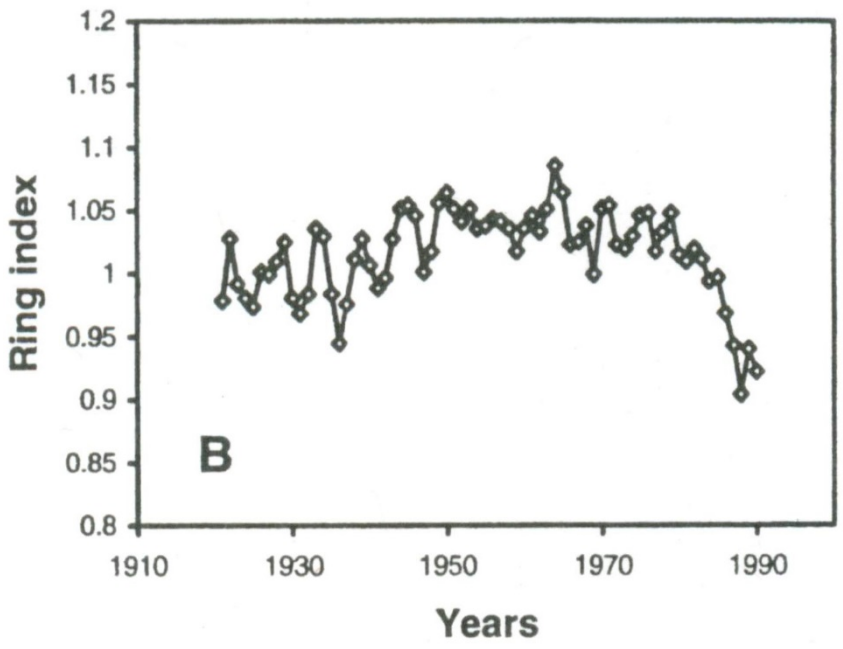


Decline of Sacred Fir (*Abies religiosa*) in the Desierto de los Leones NP

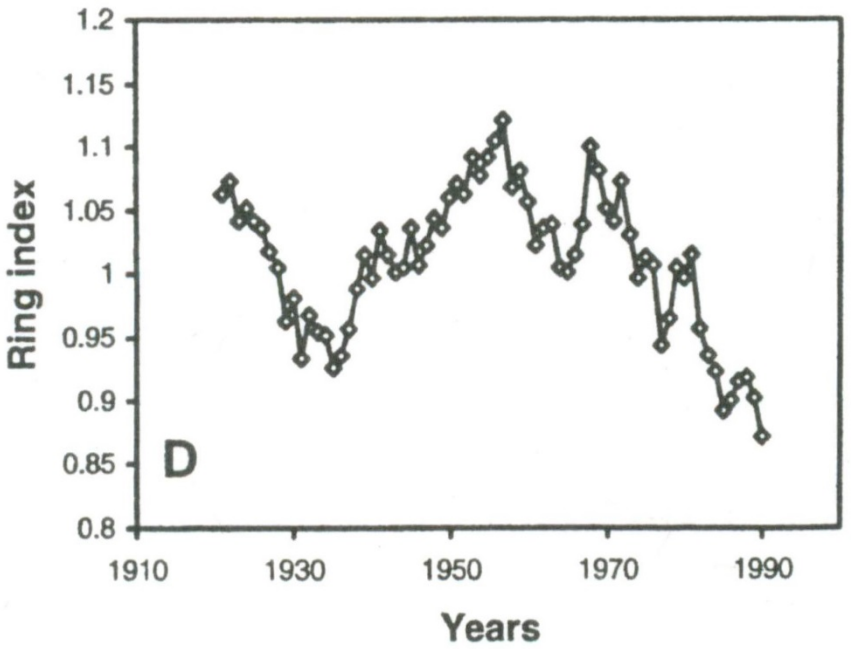
Ozone injury to *Pinus hartwegii* in the Mexico City Air Basin

Pinus hartwegii growth decline

El Ajusco

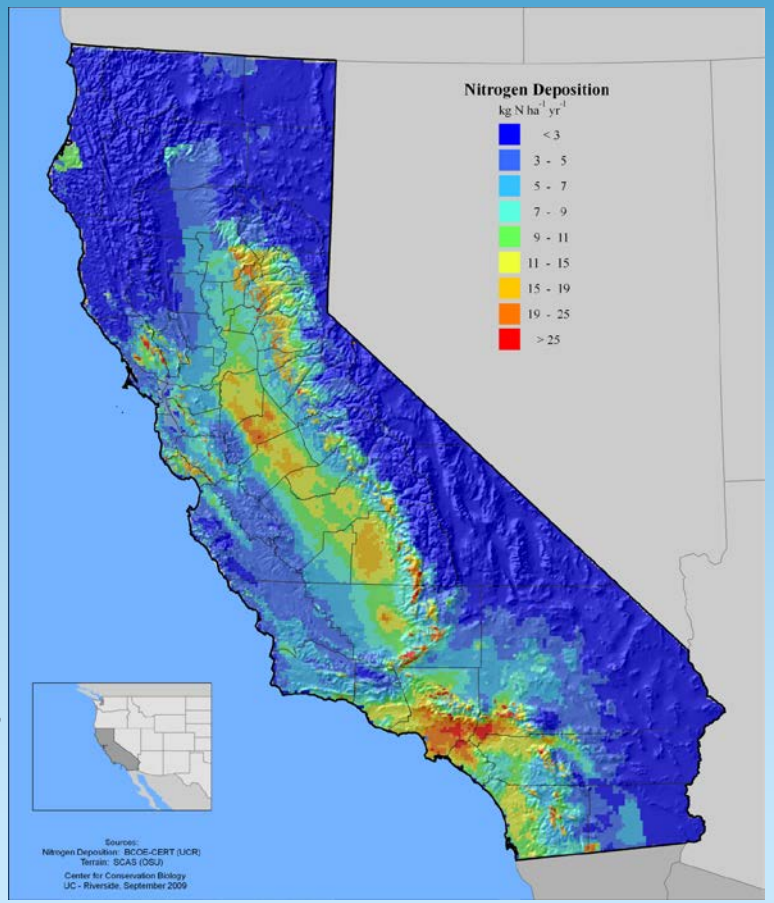


Desierto de los Leones



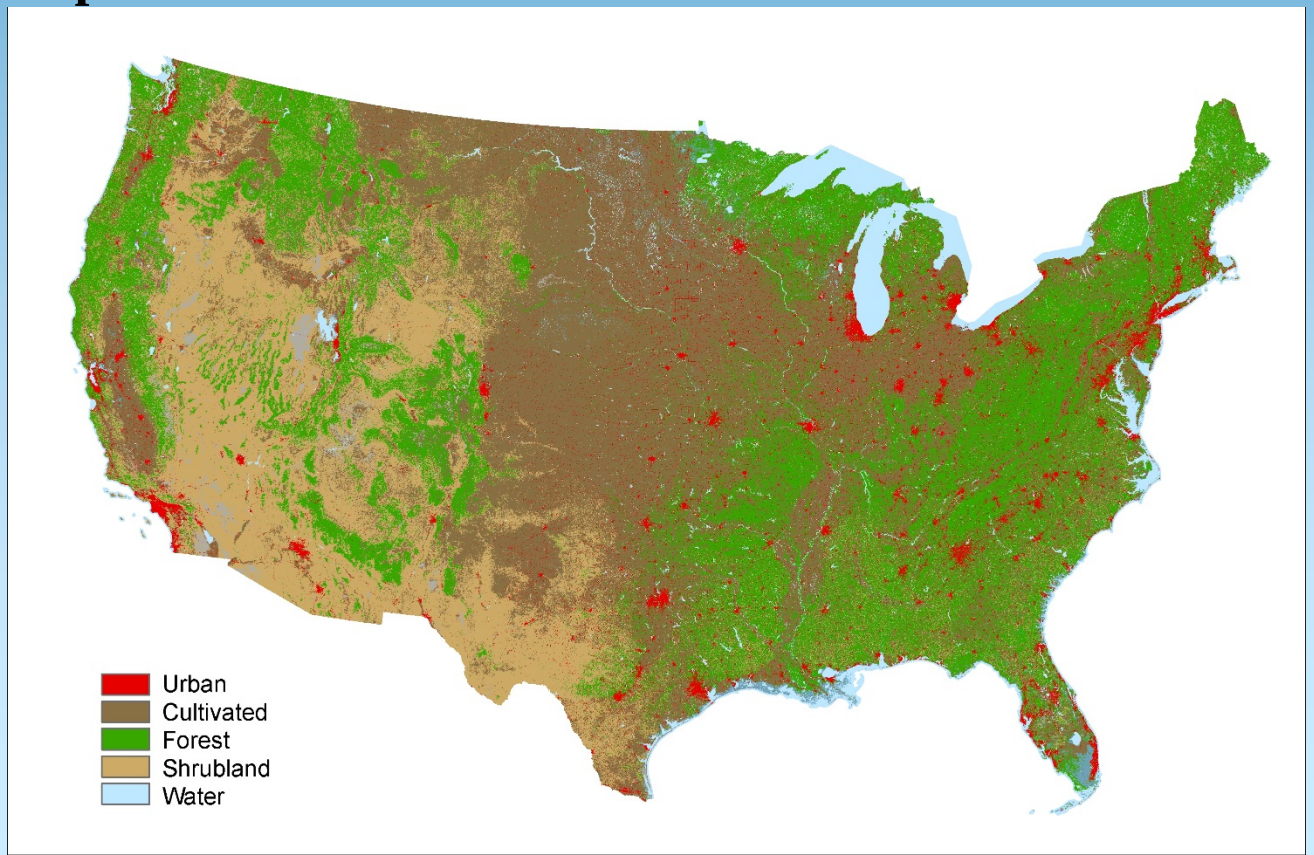
Key Points

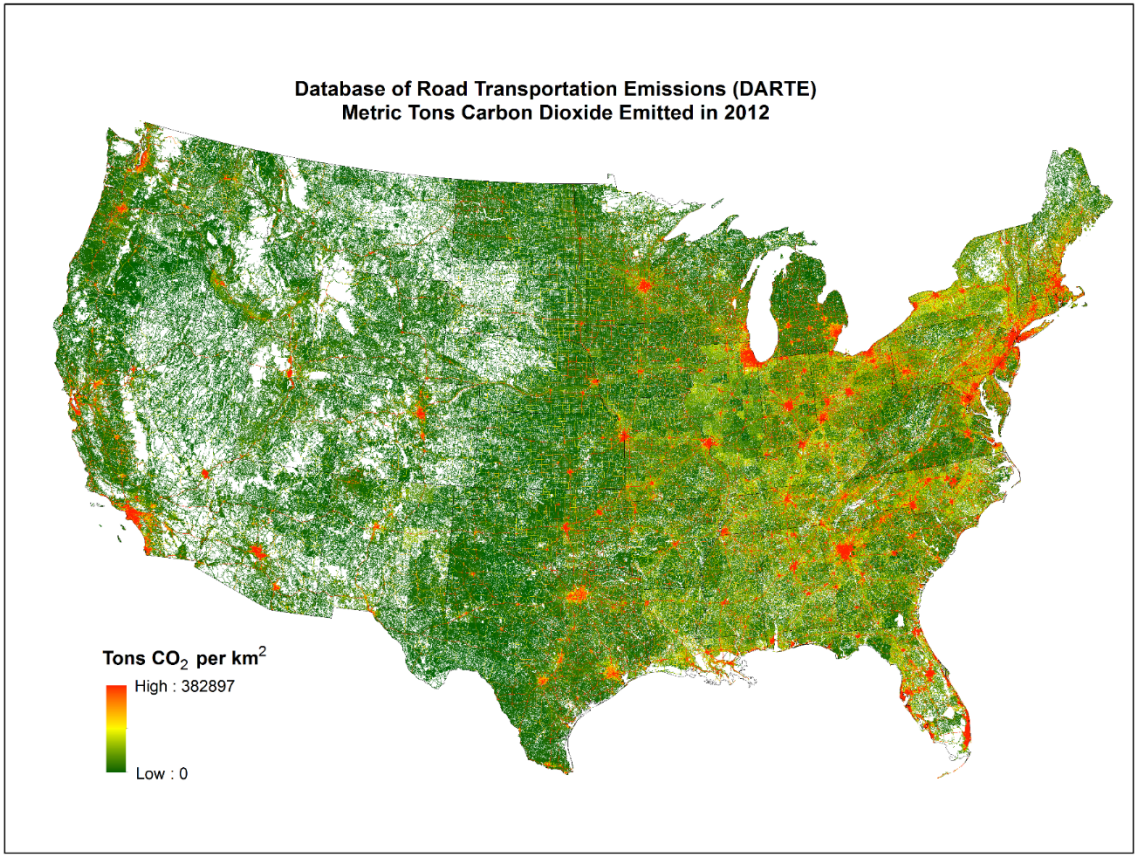
- Many ecosystems are affected by urban emissions
- Questions remain in regard to the spatial footprint of those emissions; i.e, long-range transport of particulate N? Elevated ozone in downwind ecosystems
- Urban emissions can lead to elevated N deposition, but with steeply declining deposition with distance from the source area
- This is largely due to high deposition velocity of HNO_3 and NH_3
- Such fine scale variation in deposition fluxes are not observed in large-scale monitoring networks or simulation models



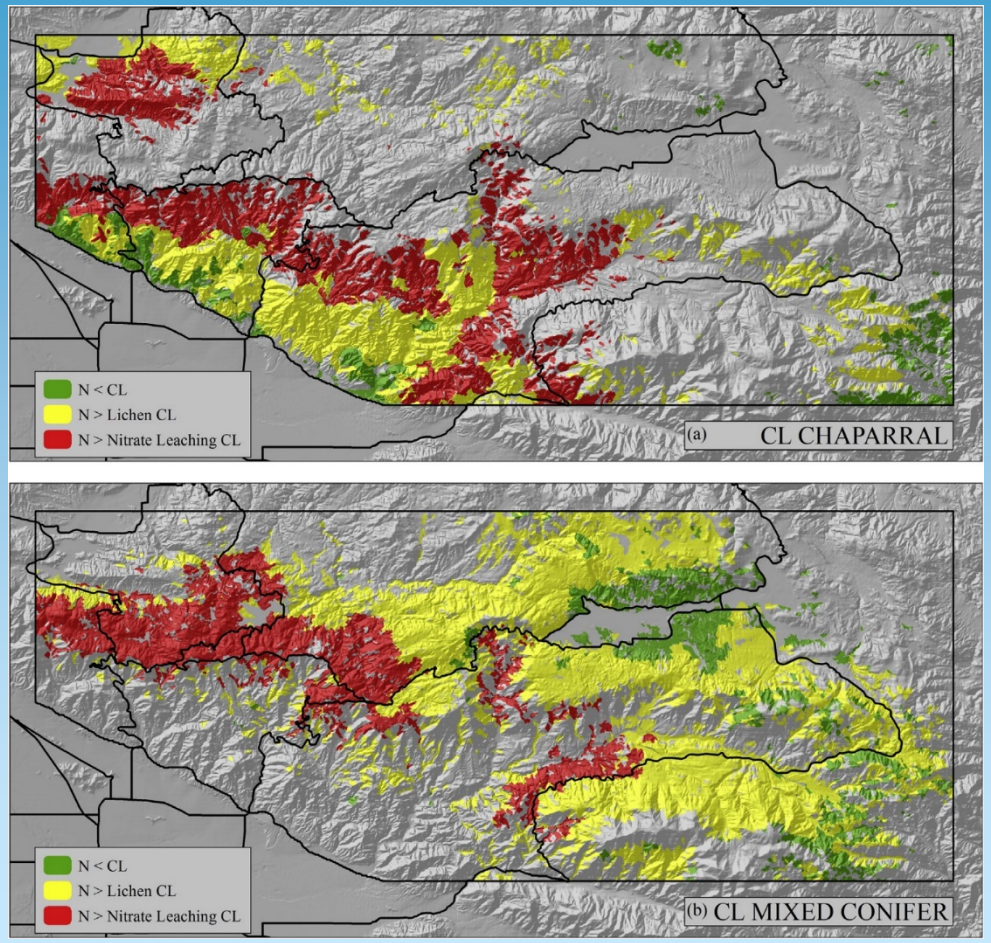
Key Points

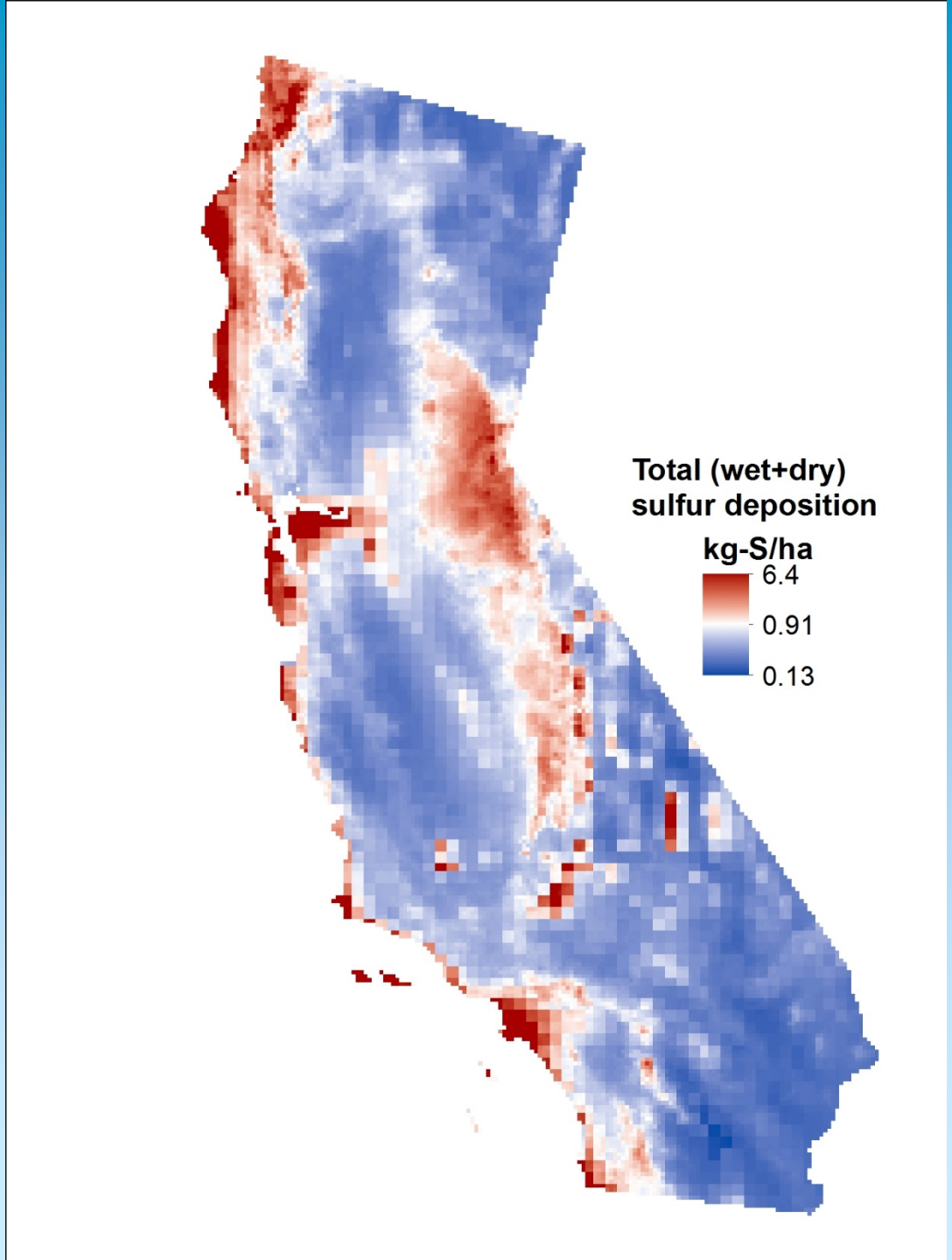
- Land use and emissions sources (urban, ag, industrial) are variable across the landscape
- Often ecosystems are affected by combinations of source types
- Urban emissions of N > S emissions because of on-road emissions of NOx and NH_3
- Thus, eutrophication or N-excess effects are common near urban source areas





https://daac.ornl.gov/CMS/guides/CMS_CO2_Relationships.htm


N < CL
N > Lichen CL
N > Nitrate Leaching CL
(a) CL CHAPARRAL
N < CL
N > Lichen CL
N > Nitrate Leaching CL
(b) CL MIXED CONIFER


Total (wet+dry)
sulfur deposition
kg-S/ha
6.4
0.91
0.13